

REMARKS/ARGUMENTS

Claims 1, 2, 6-8, 12, 13, and 17 are now present in this application.

Claims 1, 7, and 13 have been amended, and claims 3-5, 9-11, and 14-16 have been canceled. Reconsideration of the application, as amended, is respectfully requested.

Rejection of Claims 1-4, 7-10, and 13-15 under 35 U.S.C. § 102(b)

Claims 1-4, 7-10, and 13-15 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Giewont et al. (US 6,388,327). This rejection is respectfully traversed.

Giewont et al. disclose a capping layer for a semiconductor structure. The capping layer is deposited over a silicide-forming metal and has a composition such that nitrogen diffusion therefrom is insufficient to cause formation of an oxynitride from an oxide layer on the underlying silicon. The capping layer may be a metal layer from which no N atom diffusion occurs, or one or more layers including Ti and/or TiN arranged so that N atoms do not reach the oxide layer. A method is also described for forming the Ti and TiN layers. It is advantageous to deposit non-stoichiometric TiN deficient in N, by sputtering from a Ti target in a nitrogen flow insufficient to cause formation of a nitride on the target.

It is noted that the limitations of claims 3-5 have been incorporated into independent claim 1, i.e., the TiN_x layer is formed by a sputtering

process, a ratio of N₂ to Ar in a gas used in the sputtering process is approximately 3:1. It is respectfully submitted that Giewont et al. do not teach this feature.

It is also noted that the limitations of claims 3-5 have been incorporated into independent claims 7 and 13, i.e., the TiN_x layer is formed by a sputtering process, a ratio of N₂ to Ar in a gas used in the sputtering process is approximately 3:1.

It is respectfully submitted that Giewont et al. do not teach this feature. As shown in FIG. 2 of Giewont et al. and the related description, the Ar flow is 40 sccm and the N₂ flow is 60 sccm in the III region. Therefore Giewont et al. disclose a ratio of N₂ to Ar in FIG.2, and the ratio is about 1.5.

Rejection of Claims 5, 6, 11, 12, 16, and 17 under 35 U.S.C. § 103(a)

Claims 5, 11, and 16 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Giewont et al. This rejection is respectfully traversed.

Claims 6, 12, and 17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Giewont et al. in view of Besser et al. (US 5,970,370). This rejection is respectfully traversed.

It is noted that the limitations of claims 3-5 have been incorporated into independent claims 1, 7, and 13, i.e., the TiN_x layer is formed by a sputtering process, a ratio of N₂ to Ar in a gas used in the sputtering process is approximately 3:1. It is respectfully submitted that Giewont et al. and Besser et al. do not teach this feature.

Giewont et al. disclose a ratio of N₂ to Ar in FIG. 2, and the ratio is about 1.5. Giewont et al. disclose in columns 1-2 that the TiN produced with N₂ flow in III region is characterized as “N-rich”. The conventional TiN in a capping layer is generally not truly stoichiometric, but includes additional nitrogen. Nitrogen atoms may thus diffuse out of the capping layer into and through the cobalt layer. In addition, N may be incorporated in the Co layer or at the Co/TiN interface during deposition of the capping layer. **The involvement of nitrogen in the cobalt silicide formation process has an undesirable effect.** Specifically, diffusion of N atoms from the TiN capping layer to the oxide layer may result in formation of an **oxynitride layer**, which **blocks diffusion of Si atoms** to the cobalt layer. A thick oxynitride may also **inhibit transport of Co atoms**. This results in **incomplete formation of the CoSi**, with a layer of unreacted Co above the oxynitride after the first anneal. This Co layer is stripped away with the TiN capping layer, leaving a thin layer of CoSi. This in turn results in a thin layer of CoSi₂ being formed in the second anneal, with discontinuities in the CoSi₂ layer.

Giewont et al. also disclose the purpose of the invention. There is therefore a need for a capping layer for the cobalt metal which in general controls the introduction of N atom into the cobalt prior to formation of the CoSi₂, and in particular avoids formation of an oxynitride between the cobalt and silicon, thereby permitting complete formation of the CoSi.

Giewont et al. teach away from the present invention because the purpose of Giewont et al. mentioned above is to **control the introduction of N atom into the cobalt prior to formation of the CoSi₂, and in particular avoid formation of an oxynitride between the cobalt and silicon.**

One of ordinary skill in the art will follow the teaching of Giewont et al. to avoid additional nitrogen in TiN layer. And increasing the ratio of N₂ to Ar will increase probability of the undesirable effect mentioned by Giewont et al., therefore it is not obvious to one of ordinary skill to increase the ratio from 1.5 to 3.

Accordingly, it is respectfully submitted that the methods of independent claims 1, 7, and 13, as well as their dependent claims, are neither taught nor suggested by the prior art utilized by the Examiner. Accordingly, reconsideration and withdrawal of the 35 USC § 103(a) rejections are respectfully requested.

Conclusion

In light of the above remarks, Applicant submits that present invention is patentable over the prior art of record. Claims 1, 2, 6-8, 12, 13, and 17 are now in condition for favorable consideration and therefore allowance of these claims is respectfully requested.

Respectfully submitted,
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